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EXPERIMENTS WITH SOME MOSQUITO REPELLENTS FOR CORN EARWORM CONTROL ON SWEET CORN [1]

JOHN W. WILSON and WALTER H. THAMES, JR.
Central Florida and Everglades Experiment Stations

Insect repellents have been more generally used against the insects that attack man than for the protection of agricultural crops. In spite of the wide popularity and high effectiveness of the hydrocarbon and phosphatic insecticides, the idea of protecting a crop by preventing insect oviposition or feeding is fascinating. This is particularly true of an insect such as the corn earworm, *Heliothis armigera* Hbn., which has a high biotic potential, a wide range of host plants and which is, under some conditions, difficult to control with insecticides.

DDT—either in a dust or a liquid form—is highly effective against the corn earworm on sweet corn when populations of this insect are low to moderate in numbers. But during periods when populations of earworms are high, adequate control is difficult to obtain. Oil-DDT mixtures applied at 48-hour intervals give the highest degree of control; however, under some conditions such applications may reduce the yield of marketable sweet corn. The cost of such frequent applications is an additional stimulant to the investigation of the effectiveness of repellents.

Dethier (1947), in his discussion of repellents, has pointed out that the investigation of repellents has been largely by the hit-or-miss trial method. This method has been used of necessity because there appears to be no relationship between repellency and chemical structure. Our knowledge of the mode of action of repellents is, thus far, limited to the simple fact that some chemicals repel insects and others do not.

Lime and Bordeaux mixture were among the first materials used for their repelling effect. These two materials have been shown to repel a number of insects, including flea beetles, leafhoppers and cucumber beetles. Plant extracts have been found to repel some insects. Derris repels the Japanese beetle (Fleming and Baker 1936), rotenone extracts and rotenone-bearing dusts alone or in combination with Bordeaux Mixture repels the Mexican bean beetle (Huckett 1941) and the Colorado potato beetle (Turner 1932). Nicotine sulfate in combination with

[1] Florida Agricultural Experiment Station Journal Series, No. 412.

Bordeaux Mixture has been reported by Marlowe (1940) to repel the melonfly, *Dacus cucurbitae*.

Various other chemicals have been reported to be effective repellents to different insects. Among these are tetramethyl thiuram disulfide for the Japanese beetle (Guy and Dietz 1939, and Pierpont 1939), emulsions of pyridine, naphthalene or creosote for pests of beets and cauliflower (Mesnil 1934), and furfurol, Dippel's oil, ammonium sulfide or Amyl acetate for ovipositing oriental fruit moths (Lipp 1929). Chamberlin (1954) tested several chemicals for repellency to the corn earworm. Of the 12 chemicals tested, only turpentine showed any promise. In a test conducted during June, 17 per cent worm-free ears were produced in plots treated with a dust containing 50 per cent turpentine. In another test conducted during August, 40 per cent turpentine-dust-treated plots produced 24 per cent marketable ears.

Materials and Methods. During the spring of 1954, six repellents effective in protecting man against mosquitoes were used in preliminary trials at Sanford and Belle Glade. During the spring of 1955, three additional repellents—as well as six tested during 1954—were used at Sanford in screening trials. All of these chemicals were obtained from the U.S.D.A., Insects Affecting Man and Animals Laboratory at Orlando, Florida, through the courtesy of Drs. W. C. McDuffie and C. N. Smith. These chemicals with the Orlando Laboratories accession numbers are listed in Table 1. The six repellents listed first in Table 1 are those used in 1954. The Orlando acquisition numbers are used hereafter for brevity.

TABLE 1.—Repellents Used in Screening Trials During 1954 and 1955 for the Control of the Corn Earworm.

Orlando Laboratory Accession Number	Repellent
0-262	Dimethyl phthalate
0-375	2 Ethyl-1, 3-hexanediol
0-523	Benzyl benzoate
0-2484	N-Butylacetanilide
0-3916	Dimethyl carbate
0-20297	O-Ethoxy-N, N - diethylbenzamide
0-283	Dibutyl phthalate
0-22542	*N, N* diethyl-m-toluamide (crude)
M-1916	A mixture of 30 per cent N-butylacetanalide, 30 per cent 2-butyl-2 ethyl-1, 3-propanediol, 30 per cent benzyl benzoate and 10 per cent "Tween 80"

For the 1954 experiments and for the screening tests conducted during the spring of 1955, a water-white mineral oil having a viscosity of 90° - 95°

Seyboldt and U.S.P. grade was used to dilute the repellents. The above-described mineral oil is marketed under the trade name Blandol and was supplied by L. Sonneborn Sons, Inc.

At Sanford, the liquid formulations were applied by means of a 1-gallon compressed-air sprayer, equipped with a MulTeeJet Nozzle set at orifice number 50015. In the 1954 experiment, the sprays were applied to both sides of the row by moving the nozzle up and down to cover the silks of the primary and secondary ears. Approximately 75 gallons per acre of the liquid were used. In the 1955 experiments, the oil-repellent mixtures were applied at the rate of about 3 milliliters per ear; this is equivalent to approximately 25 gallons per acre. The mixtures of repellent with emulsifiable DDT in water and the emulsifiable formulations of benzyl benzoate in water were applied at the rate of about 75 gallons of spray per acre. The dust formulations of benzyl benzoate were applied with a rotary-type hand duster at the rate of 20 to 35 pounds per acre. At Belle Glade only liquid formulations were used. These were applied with a Cornelius hand atomizer to the silks of each ear at the rate of two to three milliliters per ear.

At Belle Glade each of the repellents was applied to five plots of ten ears each. All of the ears from each plot were harvested and examined for the degree of earworm injury and the effect of the repellent on pollination. At Sanford in 1954 and 1955 unreplicated single row plots 66 feet long were used for each treatment. All of the mature ears were harvested and weighed. A 25-ear sample was examined for earworm injury and the effect of the repellent on pollination recorded.

Results and Discussion. For the first test at Belle Glade during 1954, the repellents were diluted in oil at the rate of 5, 12 and 25 per cent by volume. One application was made to the variety Golden Security two days after the silks had appeared. All of the repellents at these dilutions severely injured the corn plants as well as causing some interference with pollination. In the second series of tests at Belle Glade, two formulations of the repellents were used. For one formulation, 2.5 per cent by volume of the repellent was diluted in mineral oil. For the other formulation an emulsifiable concentrate containing (by volume) 16.67 per cent repellent, 50 per cent oil and 33.33 per cent Triton X-155 was diluted with water to produce a spray containing 0.025 per cent of the repellent. In these preliminary tests, some promise of control was obtained with very little interference with pollination by a single application of the above described sprays. Data from these preliminary tests are not presented.

As a result of the experience at Belle Glade, the concentration of the repellent in oil was reduced to 0.01, 0.1 and 1.0 per cent for the tests at Sanford. Each dilution of each repellent was applied to Ioana sweet corn once on the second day after first silks appeared in one series of plots. In a second series of plots two applications were made, the first at the same time as in the first series of plots and the second application was made 4 days after the first. Untreated check plots were scattered through both series of plots but there were no oil treated check plots.

The application of the repellents in mineral oil at the rates and dilutions used caused no apparent injury to the plant or husk. No reduction

in yield resulted from the repellents and mineral oil under the conditions of this test. When a comparison between the number of unfilled ears due to a lack of pollination is made between one and two applications, the injury increased in most cases where two applications were made. The per cent of worm free ears produced in plots treated once was very low and was high in plots treated twice. Although the data for two applications shows a high degree of control, later experiments showed that the control was due to the oil used as a diluent and not to the repellents. Data are given in Table 2.

TABLE 2.—Per Cent of Worm Free Ears of Sweet Corn Harvested from Plots Treated Once and Twice with 3 Dilutions of Repellents in Mineral Oil at Sanford During the Spring of 1954.

Repellent	Per Cent Worm Free Ears Treated at Dilutions of			Av. Length Unfilled Ear Tip
	0.01%	0.1%	1.0%	
		One Application *		
0-262	12	16	24	0.34
0-375	20	12	28	0.11
0-523	60	56	32	0.27
0-2484	48	36	20	0.15
0-3916	40	48	24	0.19
0-20297	52	24	24	0.12
		Two Applications *		
0-262	52	56	76	0.86
0-375	84	76	84	0.19
0-523	96	84	84	0.77
0-2484	92	64	56	0.59
0-3916	60	64	72	1.09
0-20297	96	88	80	0.61

* Per cent worm free ears from untreated check plots were: 0, 4, 0 and 0.

The differences between the per cent of worm-free ears harvested from plots treated with the different dilutions were very low. In most cases, the lower dilution produced the higher per cent of worm-free ears.

A later planting of sweet corn was treated twice on June 3 and 7 with an emulsifiable concentrate containing 90 per cent repellent and 10 per cent Triton X-155. At the time of application, these concentrates were diluted with water to 2.5, 5 and 10 per cent of repellent and applied at the rate of approximately 75 gallons of spray per acre. All of these treatments produced injury ranging from slight to very severe burning of the entire plant. The treatments producing slight plant injury included 2.5 and 5 per cent 0-523, and 2.5 per cent 0-262 and 0-375.

All of the 1955 experiments with repellents were conducted at Sanford on Calumet sweet corn. Because of the preliminary nature of the experiments, only single-row plots 66 feet long were used for each treatment. In the screening test, all nine of the repellents listed in Table 1 were diluted in mineral oil at the concentration of one per cent by volume of the repellents. Two applications were made, the first on the day after the first silks appeared and the second four days after the first application. The per cent worm-free ears harvested ranged from 28 per cent in the untreated check and 92 per cent in the mineral oil treated check, to 64 per cent for 0-22542 and 100 per cent for 0-252, 0-283, 0-523 and M-1960. It was evident that the major part of the control was due to the oil used as the diluent.

Mixtures of two of the repellents were used to test the possibility of synergistic effects. Combinations of each of the repellents with all of the other repellents in equal parts were prepared. These mixtures were diluted to one per cent by volume with mineral oil. All of the mixtures failed to control the corn earworm. Both where the repellents were used alone and as mixtures, the oil diluent seriously interfered with pollination and discolored the ear husk.

Since benzyl benzoate (0-523), in the 1954 experiments, appeared to be one of the least phytotoxic and the most effective of the materials used, it was applied at three dilutions in combination with 25 per cent emulsifiable DDT to an early and a later planting of Calumet sweet corn. Three quarts of 25 per cent emulsifiable DDT in 75 gallons of water per acre with each dilution of benzyl benzoate were applied three times. The first application was made on the day after the first silks appeared and the two subsequent applications at four-day intervals. Results from this experiment are given in Table 3. The per cent of worm-free ears from the untreated checks is very high for the first planting and normal for the second planting. The degree of control indicated in Table 3 is attributed to the DDT because of the results from other tests conducted at the same times.

TABLE 3.—Results of Tests Combining Benzyl Benzoate with Emulsifiable DDT for Corn Earworm Control on Sweet Corn at Sanford During the Spring of 1955.

Amount of Benzyl Benzoate Added to Spray	First Planting			Second Planting		
	Wt. of Unhusked Ears	Worm Free Ears	Average Length Unfilled Ear Tip	Wt. of Unhusked Ears	Worm Free Ears	Average Length Unfilled Ear Tip
	Lbs.	Per Cent	Inches	Lbs.	Per Cent	Inches
Untreated	34.3	32	0.45	27.3	4	0.16
½ pint	34.3	96	0.32	26.3	96	2.00
1 pint	31.1	96	0.60	28.8	80	0.12
2 pints	33.3	96	0.28	26.3	76	0.12
Untreated	31.2	24	0.24	18.8	0	0.06

Most of the acreage of sweet corn in Florida is treated with dust formulations for earworm control. Because of this popularity of dust preparations, benzyl benzoate and combinations of benzyl benzoate with DDT were applied three times as described in the preceding paragraph at rates of 20 to 34 pounds per acre by means of a rotary-type hand duster. All of the dust formulations used in this series of tests were prepared by The Florida Agricultural Supply Company. Results from this experiment are given in Table 4. A study of Table 4 will show that the plots treated with benzyl benzoate were very little better than the untreated check and that the combination benzyl benzoate and DDT did not give effective control of the corn earworm.

TABLE 4.—Results Obtained with Benzyl Benzoate Applied in Dust Formulations for Corn Earworm Control at Sanford During the Spring of 1955.

Active Ingredient and Per Cent	Average Amount Dust per Application	First Planting			Second Planting		
		Wt. of Unhusked Ears	Worm Free Ears	Average Length Unfilled Ear Tip	Wt. of Unhusked Ears	Worm Free Ears	Average Length Unfilled Ear Tip
	Lbs./Acre	Lbs.	Per Cent	Inches	Lbs.	Per Cent	Inches
B-b* 1	33.8	44.8	32	1.00	24.3	4	0
B-b 5	19.8	35.3	24	0.64	24.8	4	0.28
Untreated		38.7	16	0.56	15.3	0	0
B-b 0.5 and DDT 5.0	25.3	27.3	68	0.56	27.3	36	0.20
B-b 1 and DDT 5	22.5	32.8	64	0.40	24.8	16	0
B-b 10	25.3	33.8	36	0.76	24.8	4	0
Untreated		34.3	16	0.28	24.3	4	0

* Benzyl benzoate.

A fourth set of plots was treated with benzyl benzoate formulated as emulsifiable concentrates. Five emulsifiers supplied by Rohm & Haas Company were used in this experiment. The emulsifiable concentrates were prepared in the laboratory by mixing 90 per cent of benzyl benzoate with 10 per cent of the emulsifier. Immediately prior to the field application of these prepared concentrates, each of the concentrates was diluted with water to produce an emulsion containing one per cent of benzyl benzoate. These sprays were applied twice at the times previously indicated at the rate of approximately 75 gallons per acre.

The data presented in Table 5 indicate that water dilutions of emulsifiable concentrates of benzyl benzoate are not effective for the control of the corn earworm on sweet corn.

TABLE 5.—The Effectiveness of Benzyl Benzoate Formulated as an Emulsifiable Concentrate for Corn Earworm Control at Sanford During the Spring of 1955.

Emulsifier Used in Formulation	First Planting			Second Planting		
	Wt. of Unhusked Ears	Worm Free Ears	Average Length Unfilled Ear Tip	Wt. of Unhusked Ears	Worm Free Ears	Average Length Unfilled Ear Tip
	Lbs.	Per Cent	Inches	Lbs.	Per Cent	Inches
Untreated	34.8	24	0.72	29.3	8	0
Triton X-45....	35.8	32	0.68	36.3	16	0.76
Triton X-100..	36.1	28	0.88	26.8	16	0.08
Triton X-155..	36.6	28	2.16	20.3	4	0.12
Triton X-160..	36.7	28	1.24	21.3	0	0
Triton B-1956	25.3	8	1.00	33.1	8	0.48
Untreated	32.8	24	1.16	25.8	0	0.08

Summary

Six repellents, effective against insects that annoy man, applied to sweet corn in mineral oil at dilutions of 5, 12 and 25 per cent of the repellent, severely injured the corn plants. Dilutions of 0.01, 0.1 and 1.0 per cent of the repellent did not injure the plants. Later tests showed that the corn earworm control obtained was due to the mineral oil used as a diluent. Additional screening tests conducted during the spring of 1955 failed to reveal a promising repellent for earworm control among the nine chemicals tested. Field experiments with benzyl benzoate in combination with emulsifiable DDT, as a dust formulation alone, or in combination with DDT and formulated as emulsifiable concentrates with five emulsifiers also failed to control the corn earworm.

Acknowledgments

The authors are indebted to Dr. W. C. McDuffie and C. N. Smith, U.S.D.A. Orlando Laboratory, Insects Affecting Man and Animals, for making available to us the repellents used in these experiments. Dr. C. V. Bowen of the same organization assisted materially with technical advice on preparing the dust formulations. The mineral oil was supplied by L. Sonneborn Sons, Inc., the dust formulations were prepared by the Florida Agricultural Supply Company, the emulsifiable DDT was supplied by

the California Spray Chemical Corporation, and the emulsifiers were supplied by Rohm & Haas Company. The authors also wish to express their appreciation to Dr. L. C. Kuitert and Mr. Norman C. Hayslip for reading the manuscript and making helpful suggestions for its improvement.

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DRAGONFLIES IN THE TALLAHASSEE REGION [1]

WILLIAM H. CROSS
A. S. Division, Camp Detrick, Maryland

A study of the dragonflies, exclusive of the Zygoptera, was undertaken during the period between the spring of 1949 and the spring of 1952 [2] in an area including several counties in the vicinity of Tallahassee. These counties, including Jefferson, Leon, Wakulla, Gadsden, Liberty, Franklin, Jackson, Calhoun, and Gulf, make up the eastern portion of the Florida panhandle. Collecting was concentrated in localities within about ten miles of Tallahassee, but interesting records were obtained as far east as the Aucilla River and as far west as the drainage of the Apalachicola River.

Containing a wide variety of aquatic habitats, this area supports an interesting and diverse odonate fauna. In the higher red-clay hill region of northern Leon County there is a concentration of lakes of varying sizes. Most of these were formed by solution of the underlying limerock strata, many having active sinks in some part of their basin. The majority of these lakes are well filled with vegetation and offer excellent sites for collecting and studying dragonflies. Just south of Tallahassee, the land becomes sandy, much lower in elevation, and on the whole is flat, sloping gently to the coast. In this region small sinks are common, and there are springs which give rise to streams and rivers, also rich in vegetation. The Wakulla, St. Marks, and Wacissa Rivers, as well as many of their tributaries, arise in this manner. In these are found species of Odonata partial to flowing water.

Large, artificially impounded pools on the St. Marks National Wildlife Refuge, with their slightly brackish water, offer another type of habitat. The dragonfly species *Cannacria gravida*, *Erythrodiplax berenice*, and *Macrodiplax balteata* typically occur here, although the first named is not restricted to this habitat.

The Aucilla River to the east and the Ochlockonee River to the west have origins farther north. Westward the Apalachicola River drainage represents a unique region for Florida and certainly one of the most interesting from the standpoint of its

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[1] Condensed from a Master's thesis completed at Florida State University in June, 1951.

[2] The records of a few specimens collected since that time are included in the present paper.

Odonata. Several species of animals and plants not found elsewhere in the state extend their ranges into Florida along the Apalachicola River and there are indications that this may also be true with a few dragonfly species.

Byers (1930) has written the only work on Florida Odonata which was done with the purpose of covering the entire state, or even a sizable part of it. He mentioned several brief papers published before 1930 which concern dragonfiies in Florida, and a few have been written since that time. Several of these are referred to in the annotated list of species.

Approximately 990 adults, 300 nymphs, and 220 exuviae were examined and 73 species are here recorded for the nine counties listed above. The majority of the specific identifications were verified by Dr. Minter J. Westfall, Jr., of the University of Florida. This aid as well as much information on recent developments in the Odonata is greatly appreciated. Unless otherwise indicated specimens were collected by the writer and are largely in his collection.

Annotated List of Species

Tachopteryx thoreyi (Hagen). Leon Co.—Tallahassee: 1 ♂ June 19, 1949. Sight records in Leon County on May 6 and 11, 1951.

Cordulegaster fasciatus Rambur. Leon Co.—Ochlockonee River at U. S. 27: exuviae of 1 individual, June 22, 1950; Tallahassee (stream): 1 nymph. Gadsden Co.—stream 7 miles west of the Ochlockonee River on U. S. 90: 1 nymph. No adults taken.

Cordulegaster maculatus Selys. Gadsden Co.—Monroe Creek at U. S. 90: 1 nymph, February 23, 1951; stream 7 miles west of the Ochlockonee River on U. S. 90: 1 nymph, February 23, 1951 (♀ emerged, February 27, 1951). Liberty Co.—Sweetwater Creek: 1 ♂, March 24, 1951. Leon Co.—Tallahassee: 1 ♂, March 27, 1951.

Progomphus obscurus (Rambur). 9 adults from May 6 to June 10, in Leon and Liberty Counties. Nymphs collected in these as well as Gadsden and Wakulla Counties.

Progomphus alachuensis Byers. Leon Co.—Lake Bradford: about 12 adults and several exuviae, June 17 and 21, 1951. A considerable northward extension of its range.

Aphylla williamsoni Gloyd. Leon Co.—Lake Bradford: 1 ♂, June 17, 1951. Several years ago 2 ♂ ♂ and 1 ♀ were taken at Lake Jackson in Leon County. It is unfortunate that the date of capture was not recorded. Emergence in this area begins prior to June 2, on which date several exuviae were collected at pools on the St. Marks National Wildlife Refuge in Wakulla County. Single exuviae were also found at Lake Hall and Lake Jackson in Leon County and at the Wakulla River in Wakulla County.

Hagenius brevistylus Selys. Jefferson Co.—Lloyd Creek: 1 ♀, Edgar Evans, August 2, 1950. Calhoun Co.—Chipola River 3 miles south of

Scott's Ferry: 1♂, June 16, 1951. Wakulla Co.—McBride Slough: 3 nymphs, August 11, 1950.

Erpetogomphus designatus Hagen. This species is included here on the basis of the following record by Byers (1930). Liberty Co.—Near the Apalachicola River, 1♂, June.

Dromogomphus spinosus Selys. Leon Co.—Ochlockonee River at U. S. 27: 1♂, June 11, 1950. Gadsden Co.—Ochlockonee River at U. S. 90: 1 nymph, February 26, 1951 (♂ emerged in laboratory, April 16, 1951). Calhoun Co.—Chipola River 3 miles south of Scott's Ferry: 1♂ and 2♀♀, June 16, 1951. Nymphs from rivers and streams of Gadsden, Liberty, and Jefferson Counties. Descriptions for adults (Needham and Heywood, 1929) and nymphs (Wright, 1946) of *spinosus* agree well with the present specimens except that the adults have dark stripes on the fronto-clypeal suture and the base of the labrum rather than having entirely yellow "faces." It is possible that these are *D. armatus* Selys if this is a valid species.

Gomphus pallidus Rambur. Twenty-one adults taken in Leon County from April 27 to June 21. Exuviae of one individual from Gulf County (April 22), however, indicates somewhat earlier emergence.

Gomphus hybridus Williamson. Collections in this area were made by Dr. Minter J. Westfall, Jr., and have been previously recorded by him (1953b). For completeness they are listed here. Liberty Co.—Sweetwater Creek: 1♂, March 24, 1951. Gadsden Co.—Apalachicola River at Chattahoochee: 10♂♂ and 4♀♀, April 3, 1953.

Gomphus dilatatus Rambur. Leon Co.—Natural Bridge: 1♂, taken with exuviae, April 1, 1951. Calhoun Co.—Scott's Ferry on Chipola River: 1♀, May 19, 1951; Chipola River 3 miles south of Scott's Ferry: 1♀, June 16, 1951.

Gomphus lividus Selys. Adults from March 23 to May 6, in Leon, Liberty, Calhoun, and Gadsden Counties. All records discussed by Westfall (1953b) except the following: Leon Co.—Tallahassee: 2♀♀, May 6, 1951. A peculiar dipping motion during flight was several times exhibited by individuals of *lividus*. For several consecutive times the dragonfly would rise and fall approximately three feet before settling again on the ground or low grass.

Gomphus brimleyi Muttkowski. Adults about large lakes and sinks in Leon, Wakulla, and Liberty Counties from March 12 to April 27. See more complete discussion for *brimleyi* in this area by Westfall (1953b).

Gomphus minutus Rambur. Found flying from March 25 to May 2, in Jefferson, Leon, Wakulla, Gadsden, Calhoun, Jackson, and Gulf Counties. Emergence began in the laboratory on March 10. A common spring dragonfly in this area.

Gomphus australis Needham. Leon Co.—Lake Bradford: 2♀♀, March 31, 1951, exuvia of 2♀♀, April 14, 1951; sink near Dog Lake: 1 small nymph, February 15, 1951. These records extend the known range considerably northward in Florida. Because the female has been unknown since Needham described the male in 1897, the two females recorded above have been recently described (Cross, 1955).

Gomphus descriptus Banks. Needham (1943) described as *Gomphus mortimer* two males which he collected in April, 1929, at Chipola Lake (Dead Lakes) in Gulf County. One of these was taken in transformation.

Westfall (1945) considered *mortimer* synonymous with *descriptus*. The record stands as the only one from this area.

Gomphus plagiatus Selys. Wakulla Co.—Wakulla River: 1 ♀, July 30, 1949.

Gomphus ivae Williamson. Liberty Co.—Sweetwater Creek: 1 nymph, August 9, 1950 (♂ emerged, August 25, 1950), exuviae of 1 individual and 2 ♀ ♀, September 2, 1951. This material is discussed in more detail by Westfall (1953b).

Gomphaeschna antilope Hagen. Wakulla Co.—Ochlockonee River: 1 ♀, June 2, 1950. Leon Co.—Tallahassee: 1 ♀, Murray Voth, May 16, 1951.

Basiaeschna janata Say. Two specimens taken in this area, representing the first for Florida, were previously recorded by Westfall (1953b). The records are again listed here. Calhoun Co.—Chipola River 3 miles south of Scott's Ferry: 1 ♀, Robert Cumming, March 25, 1951. Gulf Co.—Wewahitchka: 1 ♂, March 26, 1951.

Boyeria vinosa (Say). Several nymphs from Leon County streams; two nymphs from Sweetwater Creek in Liberty County. No adults seen.

Anax longipes Hagen. Adults seen flying from March 12 to August 11 in Leon and Wakulla Counties. These sight records are mentioned since none were collected and since the species is unmistakable in the field.

Anax junius (Drury). Collections and sight records from February 17 to December 30 in Leon, Wakulla, Gadsden, Liberty, Franklin, and Calhoun Counties. Rather extensive swarms were occasionally seen.

Coryphaeschna ingens (Rambur). Leon Co.—Lake Jackson: 1 ♂ and 1 ♀, no date; Tallahassee: 1 nymph, April 30, 1949 (♂ emerged, May 23, 1949); Lake Jackson: 1 ♀, June 4, 1949, 1 ♀, April 27, 1951; junction of Fla. 20 and Silver Lake road: 1 ♂, April 18, 1954.

Nasiaeschna pentacantha (Rambur). 8 adults from March 31 to July 28 in Leon, Wakulla, Liberty, and Calhoun Counties. Nymphs from gum swamps, river oxbows, and streams in Leon and Gadsden Counties.

Epiaeschna heros (Fabricus). Leon Co.—Lake Bradford: 1 ♂, May 10, 1950; Ochlockonee River at U.S. 27: 2 nymphs, February 21, 1951; Tallahassee: 1 ♂, April 19, 1951. Gadsden Co.—Ochlockonee River at U. S. 27: 1 ♂, June 22, 1950. Liberty Co.—Sweetwater Creek: 1 ♀, September 2, 1951.

Gynacantha nervosa Rambur. Leon Co.—Tallahassee: 1 ♂, May 23, 1949, 1 ♀, October, 1949, 1 ♀, October 23, 1949, 1 adult, May 4, 1950 (not collected). Franklin Co.—Alligator Point: 1 ♂, September 7, 1950. A crepuscular species which probably migrates into the Tallahassee area from farther south.

Didymops transversa (Say). 7 adults from March 2 to April 14 in Calhoun, Liberty, and Leon Counties. Byers (1930) mentions a single male taken in Jackson County in April.

Didymops floridensis Davis. 12 adults from March 12 to April 14 in Leon and Wakulla Counties. On March 25, 1951 numerous exuviae were found in the drift along the shore of Lake Mystic in Liberty County but no adults were seen.

Macromia taeniolata Rambur. Gadsden Co.—Ochlockonee River at U. S. 90: 1 ♂, October 10, 1950. Calhoun Co.—Chipola River 3 miles south of Scott's Ferry: 1 ♀, June 16, 1951.

Macromia georgina Selys. Gadsden Co.—Ochlockonee River at U. S. 90: 1♂ and 1♀ (collected while in tandem), October 9, 1950; Little River at U. S. 90: 1 nymph, February 23, 1951 (♂ emerged April 25, 1951). Liberty Co.—Torreya State Park: 1♂, August 5, 1951.

Neurocordulia virginiensis Davis. Jackson Co.—Florida Caverns State Park: 2♂♂, May 11, 1950. Liberty Co.—Ochlockonee River: 1♂, May 13, 1950. Leon Co.—Ochlockonee River at U. S. 27: 1♂, June 11, 1950. Jefferson Co.—Aucilla River near Walker's Springs: 4 nymphs, February 24, 1951 (1♂ emerged, April 21, 1951).

Neurocordulia alabamensis Hodges. Jefferson Co.—Coney Branch at the Fanlew-Wacissa road: 4 nymphs, February 24, 1951. Leon Co.—stream near Silver Lake: 1 nymph, March 3, 1951. No adults taken. Westfall (1953b) mentions the above Coney Branch specimens in a discussion of this species, listed there as *Neurocordulia* sp. Needham and Westfall (1955) give the first description of *alabamensis*.

Epicordulia regina Selys. 15 adults from April 24 to July 13 in Leon, Wakulla, and Calhoun Counties. Nymphs and exuviae from along rivers and around lakes in Leon, Gadsden, and Jefferson Counties.

Tetragoneuria sepia Gloyd. 30 adults from March 3 to May 6 in Leon and Gulf Counties. The peak of the flight period of this southern species seems to occur somewhat later than that of the other species of the genus. Adults are most common during the last week of April and the first week of May.

Tetragoneuria stella Williamson. Leon Co.—Ochlockonee River at Old Bainbridge road: 1♂, April 2, 1950.

Tetragoneuria cynosura Say. 54 adults, probably this species, from March 3 to April 28 in Leon, Wakulla, Gadsden, Liberty, Calhoun, and Gulf Counties. 31 of these specimens seem to be Muttkowski's (1911) variety *simulans* in which the color on the hind wings extends to the tip of the triangle or beyond. The remaining specimens have much less color in the hind wings.

Tetragoneuria williamsoni Muttkowski. 41 adults, placed tentatively in this species, from March 2 to March 31 in Leon, Liberty, and Gulf Counties. On March 31, 1951 two pairs of *Tetragoneuria* were taken *in copulo* at Lake Bradford in Leon County. The males are both of the type here placed in *williamsoni*. The two females seem similar in all characters except for the pigmentation of the wings. In one they are clear with only a small amount of dark brown in the hind pair in the costal and subcostal spaces and along the veins in the anal triangle. The other female has in addition a dark, smoky-brown bar extending along the anterior margins of all four wings much as described by Muttkowski (1911) for *T. costalis* Selys. During the spring of 1951, 8 females without bars and 7 with bars were taken.

Somatochlora linearis (Hagen). Gadsden Co.—Little River at U. S. 90: 1♂, September 2, 1951. Byers (1934) lists the following record: Liberty Co.—"Camp Torreya": 1♀, T. H. Hubbell, July, 1925. Williamson and Gloyd (1933) also record *linearis* from Liberty County.

Somatochlora provocans Calvert. Leon Co.—Bradford Brook at Silver Lake road: 1♀, August 30, 1951. This record previously listed by Westfall (1953b). Williamson and Gloyd (1933): Liberty County in August.

Somatochlora filosa (Hagen). Gadsden Co.—Ochlockonee River at U. S. 90: 1♀, October 10, 1950, 1♀, August 31, 1951. Williamson and Gloyd (1933): Liberty County in August.

Somatochlora calverti Williamson and Gloyd. Two males taken in Liberty County on August 25, 1932 are the specimens used for the original description by Williamson and Gloyd (1933).

Perithemis seminole Calvert. 36 adults from April 14 to October 10 in Leon, Wakulla, Gadsden, Liberty, and Jackson Counties.

Celithemis eponina (Drury). 22 adults from April 23 to November 4 in Leon, Wakulla, and Franklin Counties.

Celithemis fasciata Kirby. Leon Co.—Lake Jackson: 3♂♂ and 1♀, no date, 2♂♂, June 4, 1949, 1♂, June 11, 1950; Lake Lafayette: 1♂, June 10, 1950.

Celithemis amanda Hagen. 9 adults from June 10 to September 10 in Leon, Liberty, and Jackson Counties.

Celithemis ornata (Rambur). 27 adults from March 12 to June 9 in Leon, Wakulla, Franklin, and Gulf Counties.

Celithemis verna Pritchard. Leon Co.—small pond just north of Tallahassee: 1 nymph, April 7, 1950 (♂ emerged, April 18, 1950); pond near Lake Bradford: 1♀, April 9, 1950. These records represent the first for Florida and were previously listed by Westfall (1953b).

Celithemis bertha Williamson. Leon Co.—Lake Jackson: 3♂♂, no date, 1♂, June 5, 1951; Lake Hall: 5♂♂, June 6, 1951; Lake Bradford: 1♂ and 1♀, June 21, 1951. Westfall (1952) lists the Lake Bradford female as *C. b. leonora* and one of the Lake Hall males as an intergrade between *C. b. bertha* and *C. b. leonora*. Most of the other specimens appear to be *C. b. bertha* as described by Westfall.

Macrodiplax balteata (Hagen). Wakulla Co.—Paddy Island: 1♂, H. M. Stevenson, June 6, 1950; St. Marks Lighthouse: 2♂♂ and 2♀♀, August 28, 1950, 1♂, September 2, 1950, several adults seen, October 21, 1950, 1♀, September 9, 1951.

Orthemis ferruginea (Fabricius). Wakulla Co.—Syfrett Creek: 1♀, April 28, 1951.

Ladona deplanata (Rambur). 51 adults from March 2 to April 28 in Leon, Wakulla, Calhoun, and Gulf Counties.

Libellula auripennis Burmeister. 14 adults from April 14 to August 31 in Leon and Gadsden Counties. Westfall (1943) lists records of this species for Jefferson, Leon, and Liberty Counties.

Libellula needhami Westfall. Franklin Co.—Alligator Point: 1♂, June 8, 1949, 2♂♂ and 2♀♀, June 9, 1949; Carrabelle: 3♂♂ and 3♀♀, May 12, 1951. Wakulla Co.—Wakulla Beach: 2♂♂, June 2, 1951; Panacea: 1♂, July 7, 1951.

Libellula flavida Rambur. Leon Co.—Tallahassee: 1♂, May 21, 1949, 1♂, August 4, 1954. Gadsden Co.—Quincy: 1 adult (sight record), February 26, 1950. Liberty Co.—Sweetwater Creek: 1♀, September 2, 1951.

Libellula semifasciata Burmeister. Leon Co.—Lake Jackson: 1♂, no date; Tallahassee: 1♂ and 1♀, April 30, 1949, 1♂, May 21, 1949.

Libellula pulchella Drury. Leon Co.—Lake Jackson: 1♂, no date. Wakulla Co.—near Wakulla Station: 1♂ and 1♀, September 30, 1950. These records previously listed by Westfall (1953b).

Libellula incesta Hagen. 48 adults from April 14 to September 2 in Leon, Wakulla, Gadsden, Liberty, Calhoun, and Jackson Counties.

Libellula vibrans Fabricius. 32 adults from May 2 to October 10 in Leon, Wakulla, Gadsden, Liberty, and Calhoun Counties.

Libellula axilena Westwood. 13 adults from April 28 to August 31 in Leon, Wakulla, Gadsden, and Liberty Counties.

Plathemis lydia (Drury). 17 adults from March 23 to August 5 in Leon, Wakulla, Liberty, and Jackson Counties.

Erythrodiplax minuscula (Rambur). 39 adults from March 10 to October 10 in Leon, Wakulla, Franklin, and Gadsden Counties. Byers (1930) lists *minuscula* also for Liberty County.

Erythrodiplax berenice (Drury). Wakulla Co.—St. Marks Lighthouse: 5♂♂ and 15♀♀, 7 occasions between May 20 and September 9; Wakulla Beach: 2♂♂ and 4♀♀, June 2, 1951.

Sympetrum ambiguum (Rambur). Leon Co.—Tallahassee: 1♂, Murray Voth, November 11, 1949.

Erythemis simplicicollis (Say). 53 adults from March 8 to October 19 in Leon, Wakulla, Franklin, and Gadsden Counties. Byers' (1930) records establish the occurrence of this species also in Gulf County. The nymphs were found in almost any body of static permanent water where vegetation was plentiful.

Cannacria gravida Calvert. 18 adults from May 20 to September 9 in Leon (Lake Jackson), Wakulla (St. Marks Lighthouse and Paddy Island), and Franklin (Alligator Point) Counties. Probably greater local concentrations were noted for this species than for any other. During the last of August and the first of September adults were very numerous on vegetation and along telephone lines near the St. Marks Lighthouse.

Pachydiplax longipennis (Burmeister). 62 adults from March 8 to October 11 in Leon, Wakulla, Franklin, Gadsden, and Jackson Counties. Jefferson County was represented only by the collection of nymphs. Records for Gulf and Liberty Counties are given by Byers (1930). The nymphs were collected in all types of fresh-water habitats except rapidly flowing water.

Miathyria marcella (Selys). Gadsden Co.—Ochlockonee River at U. S. 90: 2♂♂, October 10, 1950. Leon Co.—Lake Bradford: 1♀, H. T. Kelly, October 20, 1950, 1♂, R. L. Jenkins, Nov. 17, 1950. Specimens of *marcella* have previously been taken in Florida from Alachua County and southward (Needham, 1946; Bick, *et al.*, 1950; Westfall, 1953a),[3] from Louisiana (Bick, *et al.*, 1950), and from Texas (Needham, 1946) but these are apparently the first records for North Florida.

Tramea lacerata Hagen. Leon Co.—Lake Jackson: 1♂, September 7, 1951. Wakulla Co.—near St. Marks Lighthouse: 1♀, August 6, 1950, 1♂, August 28, 1950, 3♂♂, September 9, 1951; near Wakulla Station: 1 adult seen, August 11, 1950. Franklin Co.—Dog Island: 1 adult seen, September 18, 1950.

Tramea carolina (Linnaeus). 39 adults collected and sight records made from March 2 to October 10 in Leon, Wakulla, Gadsden, Liberty, Franklin, and Jackson Counties.

[3] The writer collected 15 adults of *M. marcella* at Loxahatchee and Pahokee in Palm Beach County, Florida, on March 24 and 26, 1954.

Pantala hymenea (Say). Leon Co.—Lake Jackson: 1♀, April 27, 1951, 1♂, August 2, 1954.

Pantala flavescens (Fabricius). 22 adults from June 10 to November 16 in Leon, Wakulla, Gadsden, Liberty, and Jackson Counties. Three late adults were seen on December 30, 1954, near the St. Marks Lighthouse.

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A NEW VILLIERSELLA
(Hemiptera: Reduviidae)

Joe C. Elkins
American Optical Co., Instrument Division, Atlanta, Georgia

This paper describes a third species of the African genus *Villiersella* Schouteden.

Villiersella agalma sp. n.[1]

Male, 6.4 mm. Generally testaceous; head, pronotum, pygophore and metathoracic femoral knees light piceous.

Dorsal interocular transverse impression almost obsolete (Fig. 1), present only as a faint suture. Eyes moderately large and prominent. Basal antennal segment slightly surpassing posterior pronotal border. One pair of inconspicuous spines ventro-laterally on genae; second pair ventro-laterally behind eyes and conspicuous, each equal in length to basal tibial spine. Pair of spines on basal rostral segment divergent and conspicuous; other segments lacking spines; second segment slightly bulbous; proportion of segments (basal first), 10:9:8.

FIG. 1

FIG. 2

Villiersella agalma sp. n.

Fig. 1. Head, lateral view; Fig. 2. Male pygophore and claspers.

Lengths of pronotal lobes subequal when measured along total lateral lengths. Antero-lateral pronotal spines short. Scutellar spine broken.

[1] Specific name from Greek ἄγαλμα, statue.

Spine of basal abdominal segment long and erect, subequal in length to prothoracic coxa.

Prothoracic coxa without spines; femur with three moderately long ventral spines along basal half, interspaced with several smaller spines and setae, inner lateral surface with five robust spines; tibia with three robust inner lateral spines.

Other legs spineless. Metathoracic femur surpassing abdominal apex.

Hemelytra attaining abdominal apex. Wing venation almost identical to that of *Villiersella schoutedeni* Miller 1954.

Abdomen of male ovate, pygophore longer than any abdominal segment.

Posterior border of pygophore broadly U-shaped (Fig. 2), claspers long, parallel and erect, each subequal in length to basal abdominal spine.

Allied to *Villiersella inermis* (Villiers) and *V. schoutedeni* Miller; can be readily distinguished by the faint interocular dorsal suture; also, the male pygophore lacks strongly acute processes on lateral apical margins of the posterior border.

Holotype, male, BRITISH CAMEROONS, Matute, Tiko Pl., May 1, 1949, B. Malkin. Deposited in collection of California Academy of Science. A female bearing same data as holotype seems to fit the description of *V. inermis*.

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REPORT ON A COLLECTION OF MALLOPHAGA, LARGELY MEXICAN (PART II)[1]

M. A. Carriker, Jr.

This is the second installment of a paper dealing with a collection of Mallophaga in the Louisiana State University Museum of Zoology. Many of the lice here treated were taken from birds in the state of San Luis Potosí, Mexico, by persons connected with the Museum. The remainder were collected in various parts of the United States, chiefly around Lawrence, Kansas.

The present installment terminates the treatment of the Ischnocera. The greater portion of the genus *Philopterus*—all those species not included in Part I or in the present installment —will be omitted from this report. The final part, which will appear at a future date, will contain the remainder of the species of the Amblycera, those not already treated in Part I.

This report lists all species found in the collection (excepting those of *Philopterus* as mentioned above), describing all which appear to be new and giving critical notes on, and figures of, little known or controversial forms. All measurements are in millimeters, and all drawings were prepared by me. All types have been returned to Louisiana State University, such paratypes and other duplicates as were available having been retained in my collection.

Superfamily ISCHNOCERA

Philopterus tropicalis, n. sp.
(Figures 1, 2, 3 and 4)

Type, male adult, from *Stelgidopteryx ruficollis serripennis* (Audubon), collected by R. J. Newman at Tamuín, S. L. P., México, January 4, 1947 (in L. S. U. M. Z. coll.).

Diagnosis.—Resembles in many ways *P. domesticus* (Kellogg), from *Progne subis*, but is smaller in most measurements, especially those of the head. There is much less difference in size of thoracic segments; the head is porportionately longer, with narrower frons; the anterior plate is of same width, but shorter; the prothorax is proportionately shorter and wider; and the pterothorax has much more divergent sides.

There are many differences in the shape of the abdominal sclerites and their chaetotaxy (see figures). In the figure of *tropicalis* the sternite of segment III is not shown, but it is somewhat similar to IV, shown in its proper position in front of the genital sternite.

The male genitalia are also quite different, those of *domesticus* being very much larger, with larger paramers, and a quite different basal plate

[1] Part I appeared in Nos. 3 and 4, Vol. 37, of The Florida Entomologist, 1954.

Fig. 1. *Philopterus tropicalis* n. sp. ♂, body complete except abdominal segments III and IV
Fig. 2. *P. tropicalis*, n. sp. ♂, gentalia
Fig. 3. *P. domesticus* (Kell.) ♂, head, thorax and segments of abdomen I, VII, VIII, and IX
Fig. 4. *P. domesticus* (Kell.) ♂, genitalia
Fig. 5. *Craspedorhynchus obscurus* (Giebel) ♀, head, thorax, and abdominal segments I, II, VII, VIII, and IX; also genital sternite of ♂
Fig. 6. *C. obscurus* (Giebel) ♂, genitalia
Fig. 7. *C. candidus* (Rudow) ♀, head, thorax, and abdominal segments I, II, VII, VIII, and IX; also genital sternite of ♂
Fig. 8. *C. candidus* (Rudow) ♂, genitalia
Fig. 9. *C. dilatatus* (Rudow) ♀, head, thorax, and abdominal segments I, II, and VI to IX; also genital sternite of ♂
Fig. 10. *C. dilatatus* (Rudow) ♂, genitalia

and mesosome. Figures of the body and male genitalia of *P. domesticus* are also presented in order to show the differences.

The female of *tropicalis* is not known, but it will doubtless show the same sexual differences as in *domesticus*. The species may be easily recognized by the above diagnosis and the figures given. All of the Philopteri which I have seen from neotropical swallows seem to be of this same type, but they all differ, one from another—those from *Progne dominicensis*, *P. tapera*, *P. chalybea* and *P. fuscus* all differing at least subspecifically from *domesticus*, while those from the other genera of swallows are usually specifically distinct. The specific differences in this difficult genus are often small and are not always appreciated. The species is represented by the male holotype and two female paratypes.

MEASUREMENTS OF *Philopterus domesticus* AND *P. tropicalis*.

	domesticus				*tropicalis*	
	Male		Female		Male	
	Length	Width	Length	Width	Length	Width
Body	1.50	....	1.736	....	1.32	....
Head (at clavi)	....	.325	....	.358	....	.293
Head (temples)	.532	.505	.585	.558	.49	.437
Prothorax	.22	.293	.225	.335	.175	.28
Pterothorax	.217	.402	.26	.488	.205	.39
Abdomen	.746	.685	.868	.78	.63	.586
Antennae	.175	.048	.206	.045	.175	.04
Basal plate	.194	.071		.133	.07	
Paramer	.048	.018		.026	.013	
Mesosome	.054	.076		.035	.07	

Genus *Craspedorhynchus* Keler, 1938

This Philopteroid genus is parasitic exclusively on Raptores (Falconoidea). Twenty-seven species are listed in the 1952 checklist, of which 11 are from the Western Hemisphere, with seven of neotropical origin. Eight of the 11 species found in the New World are in my collection, together with about 20 undescribed species, in addition to the four Mexican species described in this paper.

The genus, as a hole, seems to be very homogenous, there being but very few abnormal species, and, as far as I have been able to determine from the available material, no two hosts harbor the same species of parasite. I have not been able to check many parasites from closely related subspecies of hosts, but specimens from two subspecies of *Busarellus nigricollis*, *Buteo magnirostris*, and *Leucopternis albicollis* are reconizably different.

While many of the species are superficially quite similar in appearance, there are a surprisingly large number of characters by which they may be separated. The best characters for separating the species are: size and shape of head; shape of anterior plate; amount and shape of the hyaline margin surrounding the anterior portion of head; the endocarinae; the genital sternites of both sexes, and, lastly, the male genitalia.

The basal plate is fairly large, but the paramers are very small and nonmovable (merely flexible at point of attachment) and the endomeral sclerites are numerous, small, and very complicated. The chaetotaxy differs but little in the species, and as a rule the setae are exceedingly slender and delicate, so that in many cases, where great care in handling has not been taken, many setae will be missing.

Before describing the new species I wish to make a few remarks on several species which were described by Rudow, Giebel, and myself.

Craspedorhynchus obscurus (Giebel), 1874

(Figures 5 and 6)

Docophorus obscurus Giebel, Insecta Epizoa, p. 72. Host: "*Rostrhamus hamatus*" probably equals: *R. sociabilis* Vieillot, *fide* Guimaräes, 1943, p. 430, but perhaps *Helicolestes hamatus* (Temminck), another member of the same subfamily.

Dr. Guimaräes contends that the true host of this species is much more likely to be *Rostrhamus sociabilis* than *Helicolestes*, which is a very rare bird, and on these grounds I agree with him. I have a series of five males and five females of this genus from *Rostrhamus sociabilis*, collected in Colombia, and a comparison of them with Giebel's description of *obscurus* adds further proof to Guimaräes' contention. Giebel's description is very meager and most of the characters which he uses might apply to many species of the genus. However, he ends his remarks with the following words: "Das letzte Segment des Wiebschens hat eine sehr breite Einkerbung."

The apical abdominal segments of the females in this genus usually are more or less as shown in the figures. Segment VIII is usually covered almost entirely by a deeply colored tergal plate, while IX, closely fused with VIII, is almost entirely hyaline. However, in some species (including the one from *R. sociabilis*) there is a sternal sclerite which extends backward from VIII across IX and would give the appearance of the tip of the abdomen with a "sehr breite Einkerbung."

There is nothing about these specimens from *R. sociabilis* which disagrees with Giebel's description. He says: "Head longer than wide", and these measure about .91 x .81 (female), which is strong proof in favor of the host's being *R. sociabilis*, since I know of but one other species (from *Busarellus nigricollis*) with head having these proportions. The anterior margin of the anterior plate is concave, also agreeing with Giebel's description.

With so much evidence in favor of *R. sociabilis* being the host of *C. obscurus* (Giebel), and practically none against it, I would consider the matter definitely proved. The species is easily recognized by the long head, shape of anterior plate, premarginal carinae (both dorsal and ventral) and male genitalia.

Craspedorhynchus candidus (Rudow), 1870

(Figures 7 and 8)

Docophorus candidus Rudow, Zeit. ges. Naturwiss. 35, p. 457. Host: *Buteo ghiesbreghti* Du Bus equals: *Leucopternis albicollis ghiesbreghti* (Du Bus).

The description of this species by Rudow is quite useless, while Piaget merely confirms the impossibility of recognizing it. I have a series of nine males and nine females of this genus taken from the type host of *C. candidus* (Rudow), collected by myself at Cerro Tuxtla, Veracruz, México, March 19, 1940.

This species is among the smaller ones (see table of measurements), with head longer than wide, but not excessively so, as in *obscurus* (female, .88 x .845 against .895 x .80); the hyaline margin of the anterior portion of the clypeal area is very narrow, beginning near end of premarginal carinae; the anterior plate is long and narrow, scarcely widened medially, with anterior margin slightly thickened and undulating; the preantennal nodus is strongly developed, is rounded posteriorly, and has a semi-hyaline band down the center. A unique character, not present in any other species treated in this paper, is the type of anterior mandibular condyle, this being exactly as shown in the figure.

The genital sternites are slightly different and the male genitalia have a shorter than usual basal plate, with paramers and endomeral sclerites quite distinct.

Since Rudow's type of this species is certainly lost, I herewith designate a pair of this series as neotypes and the remainder as neoparatypes of *Craspedorhynchus candidus* (Rudow). For measurements see table at end of genus.

Craspedorhynchus dilatatus (Rudow), 1869

(Figures 9 and 10)

Docophorus dilatatus Rudow, Beitr. Kenntn. Mall. p. 14. Host: *Falco lagopus* equals: *Buteo lagopus lagopus* (Pontoppidan).

Docophorus taurocephalus Kellogg, 1896, Proc. California Acad. Sci. (2), 6, p. 471; pl. 65, fig. 1. Host: *Archibuteo lagopus sancti-johannis* equals: *Buteo lagopus sancti-johannis* (Gmelin).

In the 1952 checklist *C. taurocephalus* (Kell.) is given as a synonym of *dilatatus* (Rudow), and since I have no material from *B. l. lagopus* for comparison with the specimens from *B. l. sancti-johannis*, I accept this ruling.

I have before me one male and two females of this genus taken on *B. l. sancti-johannis*, collected by R. Baker in Colorado County, Texas, March 23, 1941. Kellogg's figure of *taurocephalus* is very poor, especially with regard to the head, but there is nothing about it which disagrees with the single male examined. Kellogg's measurements differ slightly, but not more, I think, than would be found in individual variation. For the male he gives: body, 2.06 against 1.91; head, .78 x .78 against .79 x .78. For the female he gives: body, 2.53 against 2.32; head, .87 x .87 against .89 x .86. Doubtless the types of *dilatatus* are also lost, but since these specimens from Texas are not from the type host they cannot be used for establishing neotypes. A figure is given of the female, showing the details of the head, thorax, and abdominal segments I, II and VI to IX, with genital sternites of both sexes and the male genitalia. There are no outstanding characters to distinguish this species, merely a combination of details which a careful examination of the figures will show.

The setae of the whole body are very slender, those of the head being longer than usual while the anterior plate has a darker, shield-shaped area over its anterior portion (see figure). The male genitalia are also quite distinctive. Complete measurements are given in the table at end of the genus. In addition to the three specimens collected in Mexico by Mr. Baker, I have in my own collection two males from the same host collected by L. Bruner at Lincoln, Nebr., October 9, 1894, and two males from same host taken at Turnavik, Labrador, by Harry Lance in August, 1934.

Craspedorhynchus umbrosus (Carriker), 1903

(Figures 11 and 12)

Docophorus platystomus umbrosus Carriker, Univ. Nebraska Stud., 3, p. 126. Host: *Leucopternis semiplumbea* Lawrence.

The original description is short and of little value, since it was compared with specimens wrongly identified as *C. platystomus* (Nit.) from "*Buteo borealis costaricensis*," a bird wrongly identified, being in reality *Buteo swainsoni*.

The species was described from a single male (female unknown), which was well mounted and is still in good condition.

Diagnosis.—It is one of the longer species (2.08) and has by far the longest head of the eight species identified (male, .868 x .78), but the width at the preantennal suture is proportionately great (.326). The anterior plate is long and slender and but little expanded medially; the preantennal portion of head is short and wide; the preantennal nodus has a narrow, clear, median stripe, found in but few species (see figure).

The genital sternite is characteristic of the species, as are the marginal carinae of the basal plate, the endomeral plates, and the seminal duct, which in this species is *double*, a tube running back from each side of the endomera, through the basal plate and disappearing in segment II. This is the only species which I have thus far examined which has two seminal ducts. The marginal carinae of the basal plate are of the same type as in *femoralis* n. sp., but longer. Measurements are given at end of the genus.

Philopterus transversifrons (Carriker), 1903

Docophorus transversifrons Carriker, Univ. Nebraska Studies No. 3, p. 127; pl. I, fig. 1. Host: *Micrastur guerrila* Cassin equals: *Micrastur ruficollis interestes* Bangs.

Craspedorhynchus transversifrons (Carriker), Checklist of Mallophaga, 1952, p. 193.

The original description of this species is very complete, as far as it goes, but it lacks many details, while the figure is very poor.

A very careful examination of the type reveals the fact that it really is a *Philopterus*, as originally described, and not a *Craspedorhynchus* at all. It lacks entirely the characters which so definitely characterize *Craspedorhynchus*, viz.—the long clypeal area and the long inner premarginal (clypeal) carinae, which do not extend beyond the front of the anterior plate. The chaetotaxy of head and abdomen also differs, as well as the mandibular condyles, while the male genitalia are decidedly not the type found in *Craspedorhynchus*.

Fig. 11. *Craspedorhynchus umbrosus* (Carr.) ♂, head and tip of abdomen, drawn from type
Fig. 12. *C. umbrosus* (Carr.) ♂, genitalia
Fig. 13. *C. brevicapitis*, n. sp. ♀, head, thorax, and abdominal segments I and II and tip of ♂ abdomen
Fig. 14. *C. brevicapitis* ♂, genitalia
Fig. 15. *C. brevicapitis*, right mandible (dorsal view)
Fif. 16. *C. tubulus*, n. sp. ♀, head, thorax, and abdominal segments I and II; also tip of ♂ abdomen
Fig. 17. *C. tubulus* ♂, genitalia
Fig. 18. *C. hirsutus*, n. sp. ♀, head, thorax, abdominal segments I, II, and VI to IX

It is very probable that *Micrastur* is not the true host, and I would consider its host as being unknown. The type series (two males and a female) have been cleared and remounted so that all details are clearly visible.

Craspedorhynchus brevicapitis, n. sp.

(Figures 13, 14 and 15)

Types, male and female adults, from *Buteo magnirostris griseocauda* (Ridgway), collected by R. Newman, at Xilitla, S. L. P., Mexico, Feb. 12, 1947 (in L. S. U. M. Z. coll.).

Diagnosis.—This is one of the smaller of the known species found in America. Indeed, the male is the smallest (1.82) of the nine identified species seen by me. The length and width of head are equal in both sexes; the abdomen of the male is very short and wider than long (.86 x .93), while that of the female is more rounded than in most species (1.24 x 1.06). The hyaline margin of the front of the head is well developed, extending backward beyond the middle of that portion of the premarginal carinae anterior to the preantennal suture. Its anterior margin is deeply indented much more so than in any other of the eight American species I have seen (see figure). The preantennal margin of the head is *straight* (very unusual); the premarginal carinae and nodi are narrow; the temporal carinae are broken in anterior portion (see figure) and the occipital carinae are only half as wide in the posterior portion.

The pterothorax is unusually small, with posterior margin strongly pointed medially and with four large, clear-cut emarginations (in reality they are pustules), from which arise the strong setae. The carinae of the pterothorax are unusually small; the male and female genital sternites are of normal size and shape, these sclerites always differing more or less in the different species (see figures).

The male genitalia are rather striking in appearance, especially the marginal carinae of the basal plate, the unusually long paramers, without marginal carinae, and the strongly developed seminal duct leading from the endomera back through the basal plate and finally disappearing in anterior portion of abdomen. The chaetotaxy is normal for the genus, the setae of the head being fairly short and those of the abdomen somewhat coarser than in most species but of normal length (about 1½ times as long as the width of the succeeding segment); the setae on the ventral surface are finer and shorter. The types, and only specimens, are not in the best condition and many setae are missing. For measurements see the table at end of the genus.

Craspedorhynchus tubulus, n. sp.

(Figures 16 and 17)

Types, male and female adults, from *Busarellus n. nigricollis* (Latham), collected by C. Shaw at Tamuín, S. L. P., México, Sept. 19, 1946 (types in L. S. U. M. Z. coll.).

Diagnosis.—Species of medium size but may be readily distinguished by the shape of the head, the marginal carinae, genital sternites, and male genitalia.

The head is longer than wide (female, .89 x .80), while that portion anterior to the preantennal suture is unusually long and narrow, with hyaline margin very wide and extending far beyond the end of the anterior plate (see figures). The anterior plate is short and wide, with straight sides which are completely covered (and concealed) by both dorsal and ventral preantennal carinae. The preantennal nodus is neither rounded nor expanded laterally, being no wider than the carina; the temporal carinae are broken in anterior portion (see figure) and the occipital carinae taper to a point at occipital margin.

The abdomen in both sexes is unusually round (male, .92 x .89; female, 1.20 x 1.13); in the male abdominal segments VIII and IX are closely fused and appear as one segment, but there is no tergal plate on IX, which is rounded posteriorly and strongly protruding.

The pleurites in both sexes are strongly developed and deeply pigmented (more so in male) and have well developed "heads" of unusual shape (see figure). In the female holotype segment IX and the genital sternites are mutilated, making them impossible to figure.

In the male the abdomen is somewhat heart-shaped, being widest at segment III, tapering from there to the rounded, narrow IX. The genitalia are distinctive (see figure). The seminal duct is well developed, but differs in structure from that of *brevicapitis*.

The basal plate is long (.45), with simple, narrow marginal carinae; the paramers are very short, with a different type of tip (not tubular as in most species), the endomeral plates are very large and of distinctive shape, although their complex structure is not always possible to differentiate clearly. The species is represented only by the female holotype and male allotype. Table of measurements appears at the end of this genus.

Craspedorhynchus hirsutus, n. sp.

(Figure 18)

Type, female adult, from *Buteo regalis* (G. R. Gray), collected by K. Abegg in Kansas (?). (Type in L. S. U. M. Z coll.).

DIAGNOSIS.—One of the smaller species (body length, 2.20), with rather short, egg-shaped abdomen, widest at segment III (1.11 x .94); the head as wide as long (.88), with short, very wide clypeal area (.26 x .38), and well developed and pigmented carinae, including the postmarginal carinae, a feature not present in many species.

The thoracic segments are small but have well developed carinae and five strong, pustulated setae on each side of posterior margin of pterothorax. The tergites are rather small, and the paratergals narrow, with small "heads," most strongly developed in segments IV to VII.

The chaetotaxy is normal and of medium length and texture, the setae of abdomen being finer than in some species. Segment IX is well developed, and hyaline, except for the posterior genital sternite, which extends across VIII and IX. The genital sternites across VI and VII are of the usual type, as is the small sclerite at their outer edges (see figure). The patch of short, thickened setae at sides of VIII is not found in all species (in the figure these setae are incorrectly shown as being on IX).

The species is represented by the female holotype and one female paratype (male, unknown).

MEASUREMENTS FOR SPECIES OF CRASPEDORHYNCHUS.

Species	Body Length	Length and Width of Head at Temples; Width at Clypeal Suture	Prothorax Length and Width	Pterothorax Length and Width	Abdomen Length and Width	Basal Plate Length and Width	Paramers Length and Width	Endomera Length and Width
Males								
C. candidus (Rudow)	1.85	.825x.79 .315	.22 x.48	.195x.575	.846x. 82	.40 x.15	.065x.025	.093x.098
C. dilatatus (Rudow)	1.91	.79 x.78 .35	.242x.434	.24 x.59	.89 x .955	.51 x.175	.054x.024	.11 x.12
C. obscurus (Giebel)	2.12	.80 x.715 .350	.22 x.415	.25 x.565	1.05 x .815	.41 x.15	.05 x.021	.084x.097
C. umbrosus (Carr.)	2.08	.868x.781 .326	.27 x.48	.22 x.62	.93 x .91	.46 x.17	.066x.026	.097x.11
C. tubulus, n. sp.	1.89	.78 x.74 .30	.21 x.42	.25 x.61	.92 x .89	.45 x.15	.05 x.026	.066x.12
C. brevicapitis, n. sp.	1.82	.74 x.735	.23 x.41	.217x.542	.86 x .93	.35 x.15	.087x.026	.076x.07
C. genitalis, n. sp.	1.90	.79 x.78 .305	.195x.467	.22 x.597	.90 x .91	.445x.15	.07 x.025	.09 x.108
Females								
C. candidus (Rudow)	2.20	.88 x.845 .33	.22 x.51	.28 x.655	1.11 x .93			
C. dilatatus (Rudow)	2.32	.89 x.86 .35	.28 x.49	.293x.695	1.21 x1.06			
C. obscurus (Giebel)	2.68	.895x.80 .38	.235x.49	.285x.65	1.46 x1.06			
C. tubulus, n. sp.	2.36	.89 x.80 .31	.25 x.50	.285x.69	1.20 x1.13			
C. brevicapitis, n. sp.	2.37	.85 x.85 .347	.26 x.50	.24 x.63	1.24 x1.06			
C. genitalis, n. sp.	2.29	.87 x.85 .35	.22 x.50	.24 x.65	1.08 x1.04			
C. hirsutus, n. sp	2.20	.88 x.88 .38-.41	.26 x.49	.303x.673	1.11 x .94			

Craspedorhynchus genitalis, n. sp.

(Figures 19 and 20)

Types, male and female adults, from *Geranospiza n. nigra* (Du Bus), collected by R. Newman at Hacienda Capulín, S. L. P., México, July 1, 1947 (types in L. S. U. M. Z. coll.).

Diagnosis.—This species resembles in some ways *C. dilatatus* (Rudow), especially in the size and shape of the head and type of male genitalia. The head is about as long as wide in both sexes (male, .79 x .78; female, .87 x .85), while that of the male of *dilatatus* is exactly the same and that of the female is .89 x .86. However, it differs from *dilatatus* in many details. The premarginal carinae are narrower, with the portion anterior to the suture much shorter, while the preantennal nodus has a prominent, median hyaline streak. The anterior plate is much narrower, scarcely expanded medially, and quite different in shape (see figures). That portion of the head anterior to the preantennal suture is also narrower. The temporal carinae are very narrow, less than half the width of those bands in *dilatatus*.

There is a difference in the shape of the thoracic segments, as well as in the abdominal tergites and their incrassations, while the genital sternite of the female is very different (see figure).

The male genitalia seem to be entirely without seminal duct (at least none is visible), the same as in *dilatatus* and *candidus*, while the basal plate is similar in shape to that of *dilatatus*. The paramers are, however, much longer in *genitalis*, and more slender, and there are the usual differences in the complicated sclerites of the endomera.

The species is represented by the female holotype, male allotype, and two male and three female paratypes. See table of measurements following the genus.

Genus *Saemundssonia* Timmermann, 1935

This genus contains numerous species already described and many more yet undescribed. It is parasitic on shore birds, gulls, terns, and other maritime hosts, and the greater portion of the described forms are from Old World hosts. There are but four species described from New World gulls, and these are quite different from the species described below from *Larus atricilla*.

Saemundssonia atricilla, n. sp.

(Figures 21, 22 and 23)

Types, male and female adults, from *Larus atricilla* Linné, collected by the author at Nuquí, Dept. Chocó, Colombia, March 3, 1951 (in coll. U. S. Nat. Mus.).

Diagnosis.—This is one of the smaller species, with slight difference in size between the sexes; the head is slightly longer than wide in the male and slightly wider than long in the female. The portion of the head anterior to the preantennal suture is long and narrow (.24 long x .24 wide at tips of premarginal carinae (female) and only .27 at the suture). The premarginal carinae are wide and heavly chitinized, with inner margin undulating; the anterior plate is composed of two portions, the main plate, with deeply colored posterior point, and a somewhat shield-shaped plate at anterior end (see figure). The gular plate is very small and the prothorax extends but slightly beneath the head; the mesosternum is small, is pointed

Fig. 19. *Craspedorhynchus genitalis*, n. sp. ♀, head, thorax, and abdominal segments I, II, and VI to IX
Fig. 20. *C. genitalis*, n. sp. ♂, genitalia
Fig. 21. *Saemundssonia atricilla*, n. sp. ♀, head, thorax, and abdominal segments I and II
Fig. 22. *S. atricilla*, n. sp. ♂, genitalia
Fig. 23. *S. atricilla*, n. sp. and *S. steganopa*, genital sternites of ♀
Fig. 24. *S. humeralis americana*, n. subsp. ♀, head, thorax, and abdominal segments I to III
Fig. 25. *S. humeralis americana*, n. subsp. ♀, genital sternite
Fig. 26. *S. haemastica*, n. sp. ♀, head, thorax, and abdominal segments I and II
Fig. 27. *S. haemastica*, n. sp. ♂, genitalia
Fig. 28. *S. haemastica*, n. sp. ♀, genital sternite
Fig. 29. *S. tricolor*, n. sp. ♀, body
Fig. 30. *Penenirmus auritus californiensis* (Kell.) ♀, head, thorax, and abdominal segment I
Fig. 31. *P. a. californiensis* (Kell.) ♂, genitalia

anteriorly and has a single pustulated seta on each side of the posterior margin; the carinae of the pterothorax consist of a curved longitudinal band extending from anterior margin of segment into tergite I and two transverse carinae extending inward from it, the anterior one shorter, slender, and pointed apically.

The genital sternite of the female is fairly simple in structure, as compared with that of other species (see figure).

The male genitalia are large and massive, characteristic of the genus, the combined basal plate and paramers extending from the posterior margin of tergite II to the tip of the abdomen. There are numerous details of structure, both in paramers and endomera, which distinguish the species.

Compared with the other American species of the genus, it differs from *S. gonothorax (Larus marinus)* in the shape of the head and from *S. lari* and *tridactyla (L. hyperboreus* and *Rissa tridactyla)* in the male genitalia. I have no data on *S. parva* (Piaget) from *Larus dominicanus.*

S. atricilla seems to be most nearly related to a series of undescribed specimens from *Larus serranus* Tschudi, of Peru, resembling also, but in a lesser degree, specimens from *Larus modestus* Tschudi, also from Peru. For measurements see table at end of the genus.

The species is represented by the female holotype, male allotype and eight male and three female paratypes, also a male and female from the type host collected by myself at Lincoln, Nebraska, March 11, 1900, and by two males and a female from the type host collected by R. Newman at Baton Rouge, La., August 19, 1947, these three specimens being in the coll. of the L. S. U. Museum of Zoology.

Saemundssonia humeralis americana, n. subsp.

(Figures 24 and 25)

Type, female adult, from *Numenius a. americanus* Bechstein, collected by Rollin Baker in Colorado Co., Texas, May 25, 1940 (in coll. L. S. U. M. Z.).

Diagnosis.—Resembles strongly *S. h. humeralis* (Denny), from *Numenius arquata,* but is easily separated on size alone, being very much smaller in all measurements. Body (female) 1.92 against 2.67; head, .705 x .792 against .825 x .945 (width at suture .328 against .40). The remaining measurements are proportionately smaller (see table at end of genus). The structure of head and body is quite similar to that of *humeralis* but differs in several details, especially in the premarginal carinae and preantennal nodus, as well as in the temporal and occipital carinae.

Unfortunately no males were secured. It is possible that the genitalia will show distinguishing characters. In addition to the female holotype, the race is represented by three female paratypes. This series has been compared with a female and four males of *S. h. humeralis* (Denny), from the type host. Measurements of *S. h. humeralis* are included in the table for comparison.

Saemundssonia haemastica, n. sp.

(Figures 26, 27 and 28)

Types, male and female adults, from *Limosa haemastica* Linné, collected by J. C. Crawford, Jr., at Lincoln, Nebraska, May 20, 1899 (in coll. of M. A. C., Jr.).

DIAGNOSIS.—Differs quite strongly from both *S. limosae* (Denny) (from *Limosa lapponica*) and *S. thompsoni* Timmermann (from *L. l. limosa*). The head is of quite a different shape, being longer and narrower, and the male genitalia are quite different.

It is nearest to *thompsoni* in shape of head, but the head is longer (male, head .63 x .542 (.26 at suture) against .61 x .58; female, .67 x .62 (.303 at suture) against .67 x .66). The portion of head anterior to the preantennal suture is longer and narrower, with sides more divergent than in *thompsoni;* the anterior plate differs in shape and structure, as well as the cranial carinae. The genital sternite of the female is very close to that of *thompsoni* (see figure), but the male genitalia differ strongly, having much longer paramers and entirely different endomera.

The species is represented by the female holotype, male allotype and one male and one female paratype, also two males and two females from the type host collected by G. H. Lowery at Lawrence, Kansas, May 15, 1947, which are in the collection of the L. S. U. Museum of Zoology. There are no discernible differences between the type series and the specimens from Kansas.

Saemundssonia tricolor, n. sp.
(Figure 29)

Type, female adult, from *Steganopus tricolor* Vieillot, collected by D. S. Farner near Lawrence, Kansas, May 18, 1946 (in coll. L. S. U. M. Z.).

DIAGNOSIS.—Characterized by the extremely short, wide head, with broadly expanded temples and very short anterior portion of head (clypeal area). The anterior plate is short and wide, with short, blunt posterior tip; the gular plate is unusually large; tergite I of the abdomen is unusually wide in median portion, and tergite VIII very large; the genital sternite is also unusually large (see figures).

Unfortunately the male is unknown, but the male genitalia will undoubtedly present additional distinguishing characters. This is the first record for this genus from any species of the family Phalaropidae. The new species is represented only by the female holotype.

Saemundssonia cephalosa (Carriker) 1902

Docophorus cephalosus Carriker, Journ. New York Ent. Soc., vol. 10, p. 217; pl. 20, fig. 1. Host: *Colaptes cafer* (error) equals *Tringa s. solitaria* Wilson.

While engaged in the study of the above new forms I compared with the type of *S. cephalosa* all of the material in my collection from kinds of birds which might have been collected at Lincoln, Nebr., where the type host of *cephalosa* was taken. I found a single male in fine condition, from *Tringa s. solitaria*, collected at Mamotoco, D. Magdalena, Colombia, Sept. 5, 1913, which is an exact duplicate, in all respects, of the type of *S. cephalosa*. There is no question but what they are one and the same thing, and since *Tringa solitaria* was a common migrant at Lincoln at that time, there is no reason to doubt the correctness of this identification.

Genus *Penenirmus* Clay and Meinertzhagen, 1938

Genotype: *Pediculus albiventris* (Scopoli) = *Docophorus troglodytes* Waterston.

TABLE OF MEASUREMENTS FOR SPECIES OF *Saemundssonia*

Species	Body	Head (Pre-antennal Suture)	Pro-thorax	Ptero-thorax	Abdo-men	Basal Plate	Para-mers	Endo-mera
Females								
S. atricilla	1.68	.587x.61 (.27)	.174x.327	.25 x.456	.935x .77			
S. haemastica	2.09	.673x.62 (.303)	.185x.358	.27 x.51	1.13 x .90			
S. humeralis humeralis	2.67	.825x.945 (.40)	.217x.50	.31 x.738	1.60 x1.37			
S. humeralis americana	1.92	.705x.792 (.328)	.163x.385	.27 x.53	1.00 x .78			
S. tricolor	1.81	.62 x.725 (.28)	.195x.37	.29 x.53	1.00 x .825			
Males								
S. atricilla	1.63	.586x.57 (.24)	.193x.337	.228x.46	.87 x .705	.358x.175	.29 x.174	.217x.098
S. haemastica	1.67	.63x.542 (.26)	.185x.326	.217x.445	.868x .79	.29 x.17	.326x.174	.26 x.13
S. humeralis humeralis	2.25	.74 x.81 (.372)	.217x.456	.282x.67	1.26 x1.17	.456x.26	.434x.25	.39 x.174

A very careful study has been made of the description and figures of the type of this genus, as given by Waterston[2] and Hopkins and Clay,[3] comparing them with a pair of *Penenirmus* from *Troglodytes musculus striatulus* from Colombia, which is very similar to *albiventris*, although at least subspecifically distinct, and there can be no question of their congeneric relationship.

I have also studied a large series of the *Penenirmus* group parasitic on the Picidae (woodpeckers), having had a pair of neoparatypes of *P. auritus* (Scopoli) = *P. superciliosus* (Burmeister), from the common European woodpecker, for comparison with the New World forms. The latter are so closely related to *auritus* (Scopoli) that most of those which I have seen are conspecific with it, though all seem to be separable subspecifically.

This group of *Penenirmus*, parasitic on the woodpeckers, is very different from the genotype in the structure of the anterior portion of the head, so much so that it leads one to doubt whether or not it is congeneric with *Pediculus albiventris* (Scopoli). The woodpecker parasites of the genus *Penenirmus*, of which *P. californiensis* is the typical New World representative, are a very large group of species, found on most woodpeckers, and a surprisingly homogenic group, but further discussion of its relationship with *albiventris* will be deferred for a future article.

Penenirmus auritus californiensis (Kellogg), 1896
(Figures 30 and 31)

Docophorus californiensis, Proc. California Acad. Sci., 2 (6), p. 483; Pl. 66, fig. 6. Host: *Melanerpes formicivorus bairdi* Ridgway.

A pair of this species (male and female) from *Melanerpes f. formicivorus*, collected by R. J. Newman at Xilitla, S. L. P., México, June 12, 1947, is in L. S. U. M. Z. coll. I also have a large series of this species from Costa Rica taken on *Melanerpes formicivorus formicivorus* and another larger series from Colombia taken on *M. f. flavigula*, but I have not seen specimens from the type host *M. f. bairdi*. A careful examination of this series shows that the species varies greatly in measurements. Generally speaking, specimens from Costa Rica and Mexico are smaller than Kellogg's types and smaller than Colombian material, but there are specimens from Costa Rica as large as the types and almost as large as the largest from Colombia, but, excepting in size, no other differences were found in the whole series.

The range in measurements in Costa Rican females is body: 1.76 x .575 to 1.98 x .694; and head: .532 x .67 to .57 x .51. The range in males is body: 1.59 x .575 to 1.63 x .586; and head: .52 x .467 to .50 x .445. Mexican specimens fall within these extremes, while the largest Colombian specimen (a female) measures 2.08 x .69 (body) and .575 x .51 (head). Kellogg's types measured (female), body: 1.90 x .72; head, .60 x .53; (male), body: 1.75 x .62 and (head) .53 x .47. It may be noted that the largest Colombian female has the head smaller than the type (.57 x .51 against .60 x .53). In view of the above series of measurements it would be very foolish to attempt any separation of this series on size alone, while other differences

[2] Waterston, 1915. Zool. Jb., Abt. Syst., 39: 27, fig. F.

[3] Hopkins & Clay, 1951. Bull. Brit. Mus. Nat. Hist., Ent., Vol. 2, No. 1, p. 28, figs. 38-40.

do not exist. It is possible that Kellogg's female type was an unusually large specimen, since the measurements he gives for the male show the head to be but slightly larger than Costa Rican and Colombian males. It is also possible that an error was made in the measurements of the female. It would, therefore, seem advisable to identify specimens from all of the races of *Melanerpes formicivorus* merely as *P. californiensis* (Kell.).

This species, by the way, is very closely related to *P. auritus* (Scopoli) = *P. superciliosus* (Burm.). I have compared my specimen with a pair of neoparatypes of *auritus* and they are surprisingly alike. Kellogg states that *californiensis* differs from *superciliosus* in the presence and absence of certain setae of the prothorax and abdomen. This, however, is incorrect, since their chaetotaxy is exactly the same. The difference between the two species lies in the shorter head of *auritus*, especially the portion anterior to the preantennal suture, which in *auritus* measures (female) .13 x .25, while in *californiensis* it is .163 x .228. There are also differences in the structure of the pleurites, those of *californiensis* having the median ridge higher and more sharply defined; the pterothorax of *auritus* is wider in the female (.526 against .51) and narrower in the male (.423 against .456).

There is very little difference in the male genitalia. The width at base of paramers is the same, as well as the width of the central, deeply colored portion of the endomera, but the posterior, almost hyaline portion is longer and wider in *auritus*, and the median portion much longer, as well as the penis. Considering the very slight differences between *auritus* and *californiensis* it seems best to consider them as conspecific, so that the latter becomes a subspecies of the former.

Penenirmus auritus evagans (Kellogg), 1896 [4]

(Figure 32)

Docophorus evagans Kellogg, Proc. California Acad. Sci., vol. 6 (2), p. 480, pl. 66, fig. 2. Host: *Dryobates pubescens* = *Dendrocopus pubescens medianus* (Swainson).

This species was described from a single male; host collected at Lawrence, Kansas. In my own collection there is a single female from the type host, taken at Lincoln, Nebr., April 20, 1901. This female agrees in all respects with Kellogg's description of the male, excepting for size and slight discrepancies in chaetotaxy. He gives the head measurements as .53 x .47, while my female (which should be larger) measures only .50 x .456, with a total length of 2.06 against Kellogg's measurement of 2.00 for the male. In this group there is an average difference in size of head of .05 to .07 in both length and width. I am beginning to suspect that we cannot always depend on Kellogg's measurements. They seem to

[4] Two female adults and one female immature from *Piculus aeruginosus* (Malherbe) collected at Xilitla, S. L. P., Mexico, January 25, 1947, are practically impossible to separate from *evagans*, all head measurements being the same, not varying in any case more than .02. The anterior plate is a little longer and a trifle wider; the pterothorax and abdomen are a trifle wider. Unfortunately no males are available for comparison of the genitalia, nor have I seen the male of *evagans*. It seems best, from lack of material, to identify them merely as *P. auritus evagans*.

run greater than they should in many instances, another example being the measurements of *P. californiensis.*

In his description and figure of *evagans* the frons is noticeably wider than in *californiensis,* and he places considerable stress on this character. In my female from *D. pubescens,* which must be *evagans,* the frons is noticeably wider than in *californiensis,* being actually .022 at the tips of the preantennal carinae, while the anterior plate is wider (.108 x .10 against .108 x .087). Kellogg also says that "the trabeculae are acute and reach to end of segment I of antennae," which agrees exactly with my specimen, the clavi being longer than in *californiensis,* with very straight sides and sharp point, while in *californiensis* the posterior margin is concave and the tip less sharply pointed.

P. evagans also differs from *californiensis* in the shape of the abdominal sternites, which, in the latter species are wider (transversely) and occupy only the anterior half of the segment, while in *evagans* they are as wide as the tergites.

I have examined three females which are apparently this species, taken from *Dendrocopus scalaris giraudi,* collected by R. Newman at Ciudad del Maiz, S. L. P., Mexico, March 23, 1947, and which are in the collection of the L. S. U. Museum of Zoology.

These females are exactly like my female from *pubescens,* except for slight discrepancies in measurements and their *wider frons.* They agree in this respect exactly with Kellogg's figure of *evagans,* averaging about .09 in width, while my female from *pubescens* measures .065 and *californiensis* averages about .043. The anterior plate is also larger, being .15 x .108 against .108 x .10 for the *pubescens* female.

MEASUREMENTS OF *P. auritus auritus* AND *P. a. californiensis*

	auritus				*californiensis*			
	Male		Female		Male		Female	
	Length	Width	Length	Width	Length	Width	Length	Width
Body	1.67	....	2.04	....	1.63	....	1.93	....
Head (at clavi)	....	.347	....	.38	....	.31	....	.314
Head (at temples)	.54	.50	.575	.532	.52	.456	.545	.456
Prothorax	.14	.27	.185	.306	.185	.285	.185	.293
Pterothorax	.237	.423	.24	.52	.217	.46	.228	.495
Abdomen	.92	.553	1.27	.716	.90	.50	1.15	.685
Basal plate	.20	.094			.15	.10		
Paramer	.046	.016			.06	.026		
Endomera	.08	.053			.07	.048		

Taking into consideration the great individual variation in measurements of the series of *californiensis,* it would seem rational that the same thing would be found in *evagans.* The heads of the three females from *scalaris* measure .553 x .488; .542 x .467; and .55 x .467, while the female

from *pubescens* measures .51 x .456. I do not consider that the differences between *auritus* and *evagans* justify specific rank and have made the latter a race of *auritus*.

Penenirmus auritus varius Emerson, 1953
(Figure 33)

Penenirmus varius Emerson, Jour. Kansas Ent. Soc., vol. 26, No. 4, October, 1953, p. 134; figs. 6 and 8, p. 135. Host: *Sphyrapicus v. varius* (Linné).

I would consider Emerson's species to be a race of *P. auritus* (Scopoli). It is very close to the nominate form, resembling more closely *auritus* than any of the other races I have seen, although it is very close also to *evagans* (Kellogg). It is in no sense an outstanding subspecies.

A series of five males and three females were taken on the type host collected by R. Newman at Xilitla, S. L. P., México, on January 25, 1947.

Penenirmus auritus aurifrons, n. subsp.
(Figures 34 and 35)

Types, male and female adults, from *Melanerpes aurifrons grateloupensis* (Lesson), collected by G. H. Lowery at Ebano, S. L. P., México, February 25, 1947 (in coll. L. S. U. M. Z.).

Diagnosis.—Very close to *evagans* (Kell.), agreeing with that race in practically all measurements. *P. a. aurifrons* differs in size, shape and position of the anterior plate, that sclerite being set much further back from margin of frons. It is much shorter and differently shaped in posterior portion (see figure).

The preantennal carinae (back of suture) are considerably wider; the inner carinae which support the anterior plate are much shorter and wider in median portion; the area between the outer and inner carinae is deeply chitinized and mottled; the preantennal nodus is much smaller, tapering to a round tip; there are distinct dorsal temporal carinae, extending from preantennal nodus to anterior margin of prothorax. These are absent in the other races. The male genitalia are smaller, the basal plate being narrower and the component parts more slender (see figure). The species is represented by the female holotype, male allotype and seven male and seven female paratypes. Measurements will be found beyond.

Sturnidoecus caligineus (Carriker), 1903

Nirmus caligineus Carriker, Univ. Nebraska Stud. vol. III, p. 22, pl. III, fig. 2. Host: *Merula grayi* = *Turdus grayi casius* (Bonaparte).

Penenirmus caligineus (Carriker), Carriker, Proc. U. S. Nat. Mus., 1949, vol. 100, No. 3266, p. 384. List of types described by the author 1903-1910; Checklist of Mallophaga, Hopkins and Clay, 1952, p. 274.

When I published the list of my types in 1949, with their proper generic allocations, I had not seen authentic specimens of *Sturnidoecus* Eichler, and I do not remember whether I or Dr. Hopkins was responsible for the allocation of *Nirmus caligineus* in *Penenirmus*.

Since I had no occasion to work with this genus until the present time, this error was not previously discovered. Meanwhile, I had received from

Fig. 32. *Penenirmus auritus evagans* (Kell.) ♀, head, thorax, and abdominal segment I
Fig. 33. *P. a. varius* Emerson ♀, head, thorax, and abdominal segment I
Fig. 34. *P. a. aurifrons*, n. subsp. ♀, anterior portion of head
Fig. 35. *P. a. aurifrons*, n. subsp. ♂, genitalia
Fig. 36. *Sturnidoecus caligineus mexicanus*, n. subsp. ♀, head, thorax, and abdominal segments I, II, and VII to IX
Fig. 37. *S. c. mexicanus*, n. subsp. ♂, genitalia
Fig. 38. *Degeeriella borealis*, n. sp. ♀, head, thorax, and portions of abdomen
Fig. 39. *D. falconoidea*, n. sp. ♀, head, thorax, and portions of abdomen
Fig. 40a. *D. falconoidea*, n. sp. ♂, genitalia
Fig. 40b. *D. borealis*, n. sp. ♂, genitalia
Fig. 41. *D. genitalis*, n. sp, head, thorax, and abdominal segments I and II
Fig. 42. *D. genitalis*, n. sp. ♂, genitalia

Miss Clay neoparatypes of *Sturnidoecus sturni* (Schrank) (type of the genus) and a pair of *S. capensis* (Giebel). When these were compared with the types of *Nirmus caligineus*, the relationship was instantly apparent.

Nirmus caligineus is a typical *Sturnidoecus* in all respects and proves to be the type of that genus most commonly found on the Neotropical Turdidae, as well as occasionally on other Passeriformes of the New World. The species is easily recognized by the structure of the anterior portion of the head, the inner preantennal carinae and anterior plate extending far beyond the tips of the outer, marginal carinae.

Sturnidoecus caligineus mexicanus, n. subsp.

(Figures 36 and 37)

Types, male and female adults, from *Turdus infuscatus* (Lafresnaye), collected by R. Newman at Cerro Conejo, S. L. P., México, May 27, 1947 (in coll. L. S. U. M. Z.).

Diagnosis.—The anterior portion of the head in the whole *caligineus* group is the same, and we have the following structure: The dorsal preantennary carinae are unbroken and heavily chitinized, terminating in a slender point apically; the inner carinae, which encircle the buccal cavity, continue forward on each side of the anterior plate, but there is a third, ventral(?) carina arising from between the two dorsal carinae and extending far beyond their tips (see figure). There is a slight suture running backward between the point of the outer carinae and the median ventral one which actually forms the anterior portion of the head and encloses the anterior portion of the anterior plate.

Tho prothorax is short and much wider than long, with almost straight, slightly divergent sides; the pterothorax is larger, with strongly divergent, convex sides and posterior margin pointed medially, with a series of seven strong setae, evenly spaced, along each side. The abdominal tergites are all broken medially in both sexes, excepting in VIII, where it is entire at the posterior margin; there are no pustulated setae on the tergites as in *Penenirmus*, but there are three on each side, set in the clear space between the tergites and the posterior margin of the segment, in II to VII, and two on VIII; there are two shorter setae on each side of the posterior margin of the sternal side of the pterothorax and three on each side of the sternum; there is a single longer, heavier seta on posterior margin of tergites III to VII, just behind the spiracles; a single submarginal seta on each side of posterior margin of sternites I to VI.

The sternites are entire transversely, but widely separated from the pleurites; the genital sternite is small, ending posteriorly in a point at the anterior margin of segment VIII; segment IX is much narrower than VIII (in female), hyaline and deeply incised medially; there are five short setae on each side of posterior margin of VIII, and six short, sternal setae, pointing inward, at each side of segment.

In the male, segment VIII is short, but almost as wide as VII, while IX is longer and much narrower than VIII, with circular posterior margin set with six rather long setae on each side. The male genitalia are well developed but have a very short basal plate, expanded apically; the paramers are comparatively large, with broadly rounded tips curved inward and touching; there are deeply colored carinae extending inward from the

basal portion of the paramers which possibly support the mesosome, but this detail is not clear. These carinae are characteristic of the species; at least all of the few males of this group which I have seen possess them, and all have more or less similar genitalia. The structure of the mesosome is rather complicated and difficult to differentiate, so that there may possibly be some slight errors in the figure.

MEASUREMENTS OF THE TYPES OF *Penenirmus a. aurifrons* AND *Sturnidoecus caligineus mexicanus.*

	P. a. aurifrons				*S. c. mexicanus*			
	Male		Female		Male		Female	
	Length	Width	Length	Width	Length	Width	Length	Width
Body	1.73	....	1.99	....	1.27	....	1.45	....
Head (at coni)	....	.34	....	.358	....	.295	....	.314
Head (at temples)	.564	.477	.597	.50	.47	.445	.488	.456
Prothorax	.174	.314	.174	.30	.14	.24	.15	.267
Pterothorax	.25	.477	.26	.48	.174	.37	.195	.39
Abdomen	.955	.605	1.19	.65	.625	.445	.80	.52
Basal plate	.17	.09	....	....	.16	.11	..	....
Paramer	.05	.02	....	....	.06	.01	..	....
Mesosome	.076	.048	....	....	.08	.058	...	..

Genus *Degeeriella* Newmann, 1906

This genus has been restricted to the species parasitic on the Birds of Prey (Suborder Falcones). They are characterized by a deeply colored, heavily chitinized premarginal carina, usually corrugated along the inner margin and with well developed preantennal nodus. In some species this carina (dorsal portion) is interrupted in the median portion of the frons, in others almost interrupted, and in still others with no trace of a median constriction or interruption. There is present a more or less well developed marginal temporal carina. The preocular and postocular nodus and postmarginal carinae are less well developed and pigmented. There is no trace of a preantennal suture or anterior plate and the clavi are small, pointed and hyaline.

The thoracic segments are small, the pterothorax with strongly divergent sides and more or less transverse posterior margin, with a short median point and bearing two pairs of long setae on each side of posterior margin and one at lateral angle. The abdomen is elongated oval, the pleurites with very long heads; the legs are short and stout; and the male genitalia are minute, but with component parts rather complicated.

There is a row of six to eight (usually eight) longish setae across the median portion of the tergites and usually four to six shorter ventral setae, slightly posterior to the dorsal row, often difficult to see; there is a single

long, pustulated seta on the posterior margin of the tergites, just within the head of the pleurites on segments II to VI, in addition to the usual setae in the angles of the abdominal segments.

The genus is a large one, now containing 32 valid species and certainly many undescribed forms. While many of the species are very similar in appearance there are numerous small differences which may be used for their separation. The most important of these are the following: Size of body, size and shape of head, width and outline of preantennal carina, thoracic sternal sclerites, shape of pleurites and their heads, but perhaps the most important of all are the male genitalia.

Degeeriella borealis, n. sp.

(Figures 38 and 40b)

Types, male and female adults, from *Buteo jamaicensis borealis* (Gmelin), collected by D. S. Farner at Lawrence, Kansas, U.S.A., December 4, 1946 (in. coll. L. S. U. M. Z.).

Diagnosis.—The size of the body is medium, with head considerably longer than wide (female: .61 x .456), and almost as wide at clavi as at temples (female: .434 x .456). There is very little difference in size between the sexes.

The frons is flatly rounded, with sides of head in preantennal portion almost straight; the dorsal preantennal carina is rather wide and strongly corrugated on inner margin and deeply incised in middle of frons, but not completely interrupted; there are five transverse "canals" on each side of frons, leading to minute marginal setae; there are inner, preantennal carinae extending from the sides of mandibles and encircling the buccal cavity, and it is not completely clear whether these carinae are dorsal or ventral, but they are shown in figure as being ventral. The pulvinus is well developed, as in the entire genus, with but little variation in the different species. The temporal carinae are short, joined basally with the postmarginal carinae and preantennal nodus, as well as with the posterior mandibular condyle. These carinae seem to be dorsal, with ventral carinae absent (see figure).

The thoracic sternal plates are unusually large, especially that of the prothorax, which extends beyond the occipital margin of head. In segment I of abdomen there is a row of six setae across the middle of tergite, with another at anterior edge on each side of the median emargination; sternite VII also has six setae (figure incorrect in this detail), while II to VI have eight; there are three sternal setae on each side of median line in segments I to VI; in the female the heads of pleurites II to IV are long and wide, with rounded ends, but they decrease rapidly in size from V to VII, while in the male those of II to V are smaller and the reduction in size back to VI is very little.

The male genitalia are very small, with the ends of the paramers curved back alongside the endomera, and with a bar from the lateral wings of the endomera across the inner basal portion of the paramers; only the tip of the penis is visible. The species is represented by the female holotype, male allotype, and one female paratype. Measurements are given after the following species.

Degeeriella falconoidea, n. sp.
(Figures 39 and 40a)

Types, male and female adults, from *Falco mexicanus* Schlegel, collected by C. Shaw at San Luis Potosí, S. L. P., México, December 12, 1946 (in coll. L. S. U. M. Z.).

Diagnosis.—This species differs strongly from *borealis*, the male being much smaller than the female, and the abdomen in both sexes much slenderer; the head is much shorter, with frons narrower and sides of preantennal region more strongly divergent (female: head, .54 x .42 against .61 x .45).

The preantennal carina is of uniform width across the frons, with no trace of median interruption; the inner margin, along sides of head, is strongly corrugated, but in the frontal portion the margin is straight, and the carina narrower; there are four "canals" across the carina to marginal setae, but none near the middle of frons as in *borealis* (see figure); the preantennal nodus is much smaller than in *borealis* and the marginal temporal carinae are narrower and more uniform; the temporal carinae are faintly chitinized, but there are apparently both dorsal and ventral bands, while in *borealis* there is only the dorsal.

Measurements of Types of *D. borealis* and *D. falconoidea*.

	borealis				*falconoidea*			
	Male		Female		Male		Female	
	Length	Width	Length	Width	Length	Width	Length	Width
Body	1.93	....	2.09	....	1.73	....	2.08	....
Head (at temples)	.575	.434	.61	.456	.51	.40	.542	.423
Head (at clavi)	....	.40	....	.434	....	.358	....	.40
Prothorax	.185	.28	.195	.282	.163	.25	.195	.26
Pterothorax	.195	.45	.205	.475	.14	.326	.185	.38
Abdomen	1.13	.57	1.25	.63	1.02	.39	1.30	.542
Antennae	.23	.045	.24	.045	.217	.043	.217	.043
Basal plate	.16	.09			.15	.098		
Paramers	.04	....			.055	....		
Endomera	.04	.06			.05	.077		

The pterothorax is much smaller than in *borealis* (female: .185 x .38 against .205 x .475). The thoracic sternites are quite different from those of *borealis;* there are eight setae on tergite I, in addition to the one on each side of the median emargination, and eight on all of the remaining tergites except VII, which has six. There are six sternal setae on segments I to VI, those on VI small and set further back on segment.

The pleurites are long, all with long heads except VII, and there are deep emarginations on the anterior side of tergites just within the pleurites; the outer half of pleurites are more deeply colored than the inner (the

ventral); segment VIII is very similar to *borealis*, except for a median protuberance in *falconoidea*. There is practically no difference between the sexes, except in size and the shape and chaetotaxy of abdominal segments VII and VIII. The male genitalia are considerably larger than in *borealis* and very different in structure (see figures). The species is represented by the female holotype, male allotype and one male and three female paratypes; also a male and female in my collection from the type host collected by Lawrence Bruner at Harrison, Nebraska, February 25, 1896.

Degeeriella genitalis, n. sp.
(Figures 41 and 42)

Types, male and female adults, from *Buteo regalis* (G. R. Gray), collected by M. A. Carriker, Jr., at Lincoln, Nebraska, U.S.A., October 19, 1900 (in coll. of M. A. C.).

DIAGNOSIS.—The shape of the head differs from the other three species treated in this paper, the frons being more rounded and whole head narrower, with very little difference in width between the bases of the clavi and the temples (female: .39 against .43 and male: .39 against .423).

The preantennal carinae is interrupted in the male and female; a distinguishing character is the almost identical size of the male and female, most all measurements being either the same or very close, even those of the abdomen (see table of measurements). There is no sexual dimorphism in the head. Another character distinguishing the species is the coloration of preantennal carinae, with the corrugations almost black and with a series of five rounded clear spots (not hyaline) along each side of the head. The gular plate is small and very narrow, and the metasternum very large (see figure).

There is no distinguishing character in the abdomen, and the chaetotaxy is typical, a series of four setae on each side of median portion of tergites I to VI, and three on VII, with an extra seta on I at each side of the median emargination on anterior side; there are two sternal setae on each side of the median line of segments I to VI, slightly posterior to the dorsal setae; a long, strong pustulated seta just within head of pleurites on posterior margin of tergites II to VI.

The most distinguishing character is the male genitalia, with small basal plate and very large paramers and with differently constructed endomera (see figure).

The species is represented by female holotype, male allotype and two male and one female paratypes. A single male in rather poor condition in the collection of the L. S. U. Museum of Zoology was collected from the type host by K. Abegg in Kansas(?). Measurements follow together with next species.

(To be continued)

A Synonymic Note on Atrachelus A. and S. (Hemiptera; Reduviidae): In a recent exchange of specimens with the British Museum (Natural History) I was fortunate enough to obtain one male and two females of *Repipta mucosa* Champion which are from material used in writing the Biologia Centrali-Americana and identified by Champion. These three individuals are typical *Atrachelus (Phorobura)* Amyot and Serville, 1843, and belong to the species described by me as *Atrachelus (Phorobura) beieri.*

A formal synonymy is as follows:

Atrachelus (Phorobura) mucosa (Champion). Comb. nov.

Repipta mucosa Champion 1898, Biol. Cent.-Am., II: 271, pl. 16, fig. 17.

Atrachelus (Phorobura) beieri Elkins 1954, Proc. Ent. Soc. Wash., 56(3): 105-106 (in key), 110 (description), figs. 6, 7.

Joe C. Elkins
Atlanta, Georgia

The Sub-Tropical Entomologists of Florida was started September 14, 1955. At the four meetings held since then, 19 to 29 people with an active interest in Entomology attended. The speakers on these occasions were Dr. Maurice W. Provost, Dr. D. O. Wolfenbarger, Mr. G. Wally Dekle, and Mr. Fred H. Stutz.

At the January meeting, a motion was passed to ask the Florida Entomological Society for permission to become its first branch and to request advice as to the requirements for doing this.

All people interested in Entomology are invited to come to the meetings which are held the second Wednesday of each month at 7:30 P.M. in Room 385, North Campus, University of Miami.

Alfred S. Mills
Secretary-Treasurer

ZENO PAYNE METCALF

Dr. Z. P. Metcalf died at his home at Raleigh, N. C., January 5, 1956. Even though he had suffered poor health for many months, he died quite suddenly and unexpectedly while talking to his wife and daughter, Mrs. Micou Brown of Raleigh.

Dr. Metcalf was born in 1885 at Lakeville, Ohio, and was educated at Ohio State University where he received his A.B. degree in 1908. He earned his D.Sc. degree at Harvard University in 1924. From 1912 until the time of his death he was a member of the faculty of North Carolina State College.

Dr. Metcalf was the author of 9 books and an active member of 36 learned and professional societies. He was a key speaker at the International Congress of Zoology which convened in Paris in July, 1948, and at the International Congress of Entomologists which met in Stockholm in August, 1948. In addition he was president of 3 major national scientific organizations, The Entomological Society of America, The Ecological Society of America and the American Microscopical Society—a distinction accorded few scientists in the United States.

Dr. Metcalf also served on the editorial boards of 4 of the large national professional journals and was the author of 96 professional publications. At the time of his death he was engaged in preparing a 42-volume catalog of the homoptera of the world. Fifteen volumes had been or were in press at the time of his death, and several more volumes are nearly ready to go to press. An attempt is being made to provide means of completing the entire set of 42 volumes. Dr. Metcalf has spent much of the past 40 years collecting notes for the series. In an effort to obtain material he read and checked over 20,000 books and papers dealing with insects and visited all the principal libraries in the United States and England. The order Homoptera comprises about 4,000 described genera and 30,000 described species. The catalog now contains 512,000 references, probably the greatest catalog of any order of insects to be found anywhere in the world.

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